

# Oncologic outcomes of Tucker's laryngectomy: A single center experience

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## ABSTRACT

**Objective:** To report our experience with Tucker's operation in terms of postoperative and oncologic outcomes.

**Methods:** Medical records of patients operated for squamous cell carcinoma (SCC) of the glottis using the frontal anterior laryngectomy (FAL) between the years 2000 and 2016 were retrospectively collected. Suspension laryngoscopy and cervico-thoracic computed tomography (CT) scans were systematically performed. Statistical analysis was performed with SPSS 21 for windows. Means and Standards deviations were reported for descriptive statistics. Kaplan Meier's method was used for the calculation of survival. Survival prognostic factors were studied by the comparison of survival curves using the Log Rank Test.

**Results:** Forty-eight records were exploitable. The anterior commissure (AC) was involved in 33 cases (69%). The tumor was extended to the Morgani Ventricles in 10 patients. Ventricular folds (VF) were involved in 3 cases (6%). Vocal cord mobility was reduced in 2 cases (4%). Fourteen patients required an ipsilateral neck dissection. Histopathological examination of the specimen concluded to SCC with free margins in all cases. The mean hospital stay was  $19 \pm 4$  days. The mean time for decannulation and removal of the nasogastric tube were respectively  $13 \pm 5.1$  and  $18 \pm 7.3$  days. Infection of the tracheostomy site was the most frequent postoperative complication (19%). The 3-year and 5-year overall survival (OS) were 97%. The 3 and 5-year disease-free survival were 94%. Tumor differentiation was the only factor associated to survival ( $p=0.04$ ).

**Conclusion:** Tucker's laryngectomy is a reliable technique in early glottic cancers. It offers good local control and a reasonable postoperative morbidity rate. The relatively long hospital stay and wound healing problems remain its main drawbacks.

**Key-words:** Frontal anterior laryngectomy; squamous cell carcinoma; Oncologic outcomes

## RÉSUMÉ

**Objectif:** Rapporter notre expérience concernant les résultats post opératoires et oncologiques de la laryngectomie partielle de Type Tucker.

**Méthodes:** Il s'agit d'une étude retrospective ayant colligé les patients ayant eu une laryngectomie frontale antérieure pour carcinome épidermoïde glottique entre les années 2000 et 2016. Tous les patients ont bénéficié d'une laryngoscopie en suspension ainsi qu'un scanner cervico thoracique. L'étude statistique était réalisée moyennant SPSS 21 pour Windows. Une étude descriptive était réalisée rapportant les moyennes avec les écarts type. La méthode de Kaplan Meier était utilisée pour le calcul de la survie. La recherche des facteurs pronostiques de survie a été effectuée en comparant les courbes de survie par le test du Log Rank.

**Résultats:** quarante huit dossiers étaient exploitables. Trente trois cas (69%) ont présenté une atteinte de la commissure antérieure. La tumeur était étendue au ventricule de Morgani dans 10 cas (21%) et aux bandes ventriculaires dans 3 cas (6%). La mobilité des cordes vocales était réduite dans 2 cas (4%). Quatorze patients ont eu un curage ganglionnaire homolatéral. L'examen anatomopathologique de la pièce opératoire a conclu à un carcinome épidermoïde dans tous les cas avec des limites d'exérèse saines. La durée moyenne d'hospitalisation était  $19 \pm 4$  jours. Les délais moyens de décanulation et d'ablation de la sonde nasogastrique étaient respectivement  $13 \pm 5,1$  et  $18 \pm 7,3$  jours. L'infection du site de trachéotomie était la complication post opératoire la plus fréquente (19%). Les survies globales à 3 et à 5 ans étaient 97%. Les survies sans récurrence à 3 et à 5ans étaient 94%. Le degré de différenciation tumorale était le seul facteur associé à la survie ( $p=0,04$ ).

**Conclusion:** la laryngectomie partielle de type Tucker est une technique fiable dans le traitement des carcinomes glottiques précoces. Elle offre un bon contrôle local de la maladie tout en gardant un faible taux de morbidité. La durée d'hospitalisation relativement prolongée ainsi que les problèmes de cicatrisation restent les principaux inconvénients de cette chirurgie.

**Mots clés:** Laryngectomie frontale antérieure ; Carcinome épidermoïde ; Résultats oncologiques



## INTRODUCTION:

Prognosis of glottic cancer is considered one of the best among upper aerodigestive tract malignancies with a 5-year overall survival ranging between 73% and 90% in early stages [1]. Therefore, satisfactory functional results are more and more requested in the management of these tumors. In seek of a well adapted surgeries offering at the same time good oncologic results and lower morbidity rates, a wide range of open techniques was developed by European surgeons during the second half of the 20th century. In 1879, Tucker et al [2], described the frontal anterior laryngectomy (FAL) with epiglottic reconstruction after modifying an operation previously described by Sedlacek. A relatively technically easy partial surgery, The FAL is indicated in early tumors involving one or both vocal cords (VC) with or without extension to the anterior commissure (AC). Mobility of both arytenoids is a crucial condition that should be verified before performing the FAL [3]. For many authors, Tucker's operation offers good oncologic results [3-6]. Besides, as reported by Tucker, the neolarynx allows closure of the glottis while swallowing as well as a satisfactory phonation [2]. Consequently the FAL became a reliable therapeutic option in early glottic tumors. In this study, our purpose was to report our experience with Tucker's operation in terms of postoperative and oncologic outcomes.

## METHODS:

This is a single center study performed in Salah Azaiez Oncology Institute of Tunis, Tunisia in the Head and Neck Surgery Department between the years 2000 and 2016.

We retrospectively reviewed the medical records of patients who underwent Tucker's FAL with Epiglottic Reconstruction for early Laryngeal Squamous Cell Cancer (SCC) during 17 years. We included in this study T1 and T2 early glottic SCC treated by FAL. Patients who were previously treated by external beam Radiation therapy (RT) were excluded from the study. Other histological types of tumors were not included. Incomplete medical files were removed.

Data was gathered from the records and noted on a model sheet. Epidemiological findings including age, sex, cigarette smoking, alcohol beverage, associated comorbidities were collected. Initial tumor staging, histological grade, length of hospital stay, postoperative complications, decannulation delay, nasogastric tube removal times were recorded.

Preoperative evaluation: All patients have benefited from complete head and neck and general examination. Suspension endoscopy under general anesthesia coupled to an office nasofibroscope was done in all cases. A cervical and thoracic-abdominal-pelvic computed tomography (CT) scan was systematically performed allowing the staging of the disease following the UICC TNM classification of glottic tumors version

2009 [7]. Therapeutic decisions were made within a multidisciplinary committee. All patients underwent pneumological examination with spirometry in order to rule out any potential obstructive pulmonary disease contraindicating partial laryngeal surgeries. All patients have benefited of anesthesia evaluation before surgery.

Surgical technique: A tracheostomy was performed in the first place. Then the surgical procedure was divided in two steps: tumor resection and reconstruction. The larynx was approached by cervical incision facing the cricothyroid membrane. The thyroid cartilage is exposed after separation of the midline muscles. The perichondrium is incised and separated into two flaps. Delphian lymphadenopathies are picked for frozen sections examination. Two vertical cuts through the thyroid cartilage are realized. The larynx is then opened vertically from the less affected side. The cancerous lesion is removed under direct vision with the anterior portion of the vestibular folds, the anterior commissure, subglottic 1cm and a part of the thyroid cartilage. The resection is extended to the arytenoids if the vocal process is involved. Ipsilateral neck dissection of levels (II, III, IV) is realized for T2 tumors.

Reconstruction time begins by grasping of the petiole of the epiglottis downwards after the section of the hyo-epiglottic and glosso-epiglottic folds with scissors or electric bistoury. The superior mucosal attachments of the epiglottis are preserved. The inferior edge of the epiglottis is sutured to the edge of the cricoid cartilage. Overlaying strap muscles are sutured together with minimal tension.

Statistical analysis: Statistical analysis was performed with SPSS 21 for windows. Means and SDs were reported for descriptive statistics. Univariate analysis was realized. The 3 and 5-years overall survival (OS) as well as the 3 and 5 years disease free survival (DFS) were reported. Kaplan Meier's method was used for the calculation of survival. Survival prognostic factors were studied by the comparison of survival curves using the Log Rank Test. The Chi-square test or Fisher's exact test was used for comparison of frequencies. A p value <0.05 was considered as statistically significant.

## RESULTS:

Forty-eight medical records were exploitable. An average of 3 interventions per year was noted. The mean age was  $57 \pm 7$  years ranging between 44 and 77 years. The sex ratio was 47:1. Twenty-five patients (52%) were cigarette smokers. Alcohol beverage was associated with smoking in 14 cases (81% of smokers). We didn't note any case of chronic laryngitis. Associated comorbidities were essentially diabetes mellitus (4.2%) and hypertension (10.4%).

Hoarseness was a constant sign. It was associated with exertion dyspnea in 2 cases. Patients sought medical consultation at a mean delay of  $9 \pm 3.5$  months after the first symptom manifested ranging between 6 and 12 months. Physical examination was normal except

a cervical 1cm-lymphadenopathy in a patient. It was ipsilateral to the laryngeal lesion.

Suspension laryngoscopy under general anesthesia showed a fungating tumor in 36 cases (76%). The lesion was ulcerative in 4 cases (8%) and infiltrating in 4 cases (8%). An irregular Leucokeratotic lesion was observed in 4 cases (8%). The tumor was limited to both vocal cords (VC) in 13 cases (27%). It was strictly limited to the right VC in 15 cases (31%) and the left one in 7 cases (15%). The anterior commissure (AC) was involved in 33 cases (69%). The tumor was extended to the Morgani Ventricles in 10 patients. It was limited to the floor of the ventricle in 6 cases. Ventricular folds (VF) were involved in 3 cases (6%). No subglottic extension was noted. VC mobility was reduced in 2 cases (4%). Arytenoid mobility was conserved in all cases. Suspension laryngoscopy findings were summarized in table 1.

**Table I: Tumor endoscopic Description**

Tumor Description	Number of patients
<b>Aspect</b>	
Fungating	36 (76%)
Ulcerative lesion	4 (8%)
Infiltrating lesion	4 (8%)
Leucokeratotic lesion	4 (8%)
<b>Localization</b>	
Right sided	15 (31%)
Left sided	7 (15%)
Bilateral	13 (27%)
<b>Extension</b>	
Anterior commissure	33 (69%)
Morgani ventricles	10 (21%)
Ventricular folds	3 (6%)
Subglottis	0
Arytenoids	0

Histopathological examination showed a SCC in all cases. Carcinoma in situ was observed in 2 cases. Micro invasive carcinoma was found in 5 cases. Thirty-two patients presented a well-differentiated carcinoma (67%) while 7 patients presented a moderately differentiated carcinoma. The remaining two patients presented a verrucous carcinoma.

CT scan of the larynx concluded to a total or a partial thickening of the VC in 45 cases. Backflow of the paraglottic space was observed in three cases. Six patients presented a supra glottic extension to the VF and the Morgani Ventricles. The AC was involved in 29 cases. The CT scan was normal in 3 cases. The pre epiglottic and paraglottic spaces were intact in all cases. Neither suspicious lymphadenopathies nor distant metastases were observed.

Tumors were classified as follow: twenty one tumors (44%) were classified T1N0M0, 1 (2%) T1N1M0, 13 (27%) T1bN0M0 and 13 (27%) as T2N0M0.

In all cases, surgical resection was extended to the anterior 2/3 of the thyroid cartilage, the AC and the anterior portion of the VF. Besides, 17 patients (35%) underwent a partial or a total resection of the arytenoids. VFs were resected in totality in 33 patients (69%). Controlateral VC was partially conserved in 25 patients

(52%): 13 (27%) T1a, 8 (17%) T1b and 4 (8%) T2.

Systematic cavity margins were realized in all the interventions. After frozen sections examination, margins were involved in 6 cases. Further resections were needed.

Fourteen patients required in addition an ipsilateral neck dissection of Level II, III and IV: in thirteen cases for tumor classified T2N0 and in 1 case for tumor classified T1N1.

Histopathological examination of the specimen concluded to SCC with free margins in all cases. No metastatic lymph nodes were observed after examination of the neck dissection specimen.

The Mean Hospital stay was 19  $\pm$ 4 days ranging between 9 and 44 days. Infections and wound healing problems were the main postoperative complications. In fact, 9 patients (19%) developed an infection in the tracheostomy site. Pseudomonas Aeruginosa and Klebsiella Pneumonia were isolated in the majority of cases. Antibiotherapy was initially probabilistic then adapted to the antibiogram. The evolution was favorable in all cases. The remaining complications were cervical emphysema (2 cases), hematoma (1 case), and accidental withdrawal of the nasogastric tube (2cases).

Two patients developed an anterior glottic synechia as a long term complication. It was managed later with transoral laser surgery.

Median decannulation time was 13  $\pm$ 5.1 days ranging between 5 and 44 days. The median time for nasogastric tube removal was 18  $\pm$ 7.3 days ranging between 8 and 44 days. All patients had benefited from an office endoscopy before discharge. It was normal in 73% of cases. It showed an inflammatory aspect of the mucosa in four cases, a glottic synechia in two cases and a granuloma in 3 cases.

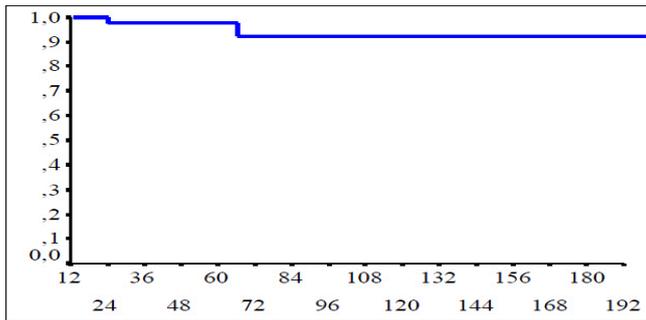
Average follow-up was 61 months ranging between 13 and 199 months. Local and locoregional recurrences occurred in 6 patients (12.5%). One early subglottic local relapse occurred 2 months after surgery. Suspension laryngoscopy showed an infiltrating tumor in the anterior subglottis. Biopsy concluded SCC. The patient underwent total laryngectomy (TL) and adjuvant radiation therapy (RT). Fourteen months later, the patient presented a second relapse in the neopharynx and died after 7 months. The remaining 5 recurrences occurred in a mean delay of 40  $\pm$ 10 months ranging between 7 and 96 months. Two patients presented locoregional relapses while 3 presented only local ones. All 5 cases were salvaged by TL followed by adjuvant RT. The evolution was favorable in 4 cases. One patient presented a second regional relapse treated by chemotherapy. The patient was then lost to follow-up. We recorded two cases of distant pulmonary metastases including one associated to locoregional relapse. A palliative chemotherapy was given. One patient died from his disease after one month. The second responded well to the therapy and is still in follow up. Recurrences are summarized in table 2.



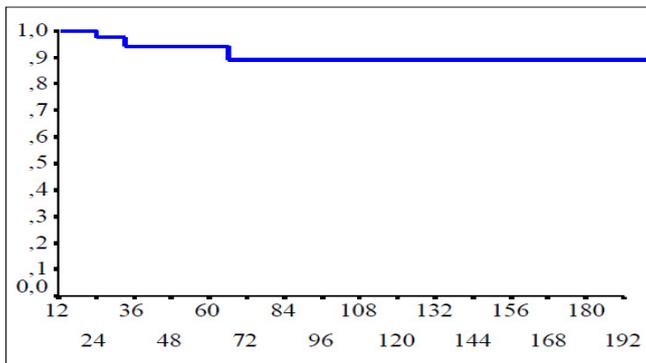
The 3-year and 5-year overall survival (OS) were 97%. The 3 and 5-year disease-free survival were 94% (figures 1 and 2).

**Table 2: Recurrences and their management**

Recurrences	Number of patients	Salvage treatment
Local	4	TL+ adjuvant RT
Loco regional	2	TL+ adjuvant RT
Loco regional + distant metastasis	1	Palliative chemotherapy
Distant metastasis	1	Palliative chemotherapy



**Figure 1:** overall survival of the 48 patients



**Figure 2:** Disease free survival of the 48 patients

The 5-year overall survival in T1 tumors was 100% while it was 90% in T2 ones. This difference was not statistically significant ( $p= 0.4$ ). The 3-year survival rate in well-differentiated tumors was 96% while it was only 50% in moderately differentiated tumors. This difference was statistically significant ( $p= 0.04$ ) (table 3).

**Table3: Survival according to Tumor's T stage and degree of differentiation**

	3 years survival	5 years survival	P
T stage			
T1	100%	100%	0.4
T2	90%	90%	
Histopathological grade			0.044
Well differentiated	96%	96%	
Moderately differentiated	50%	Insufficient follow up	

**DISCUSSION:**

Frontal anterior laryngectomy (FAL) with epiglottic reconstruction commonly known as Tucker operation is justified by its functional satisfactory results. This open technique is classically indicated in early T1 and T2 glottic cancer. Impairment of VC mobility, subglottic extension, massive involvement of the AC, cartilage infiltration, and severe lung disease are usually considered as contraindications to the FAL by European authors [6, 8]. According to Lawson et al [5], the FAL could be realized in patients with reduced VC mobility since that the arytenoids are intact. In fact, VC mobility could be impaired due to the tumoral mass or an invasion of the recurrent laryngeal nerve or the crico arytenoid joint. A subglottic extension superior to 1cm is considered a contraindication to the FAL according to Tucker [2]. In more recent reports, this extension should not exceed 0.5cm [6, 8]. The AC was involved in 69% of cases in this study. The AC remains a risky subsite due to the possible extension to the thyroid cartilage and the subglottis [9]. The deep infiltration of the Morgani ventricle exhibits a high risk of oncologic failure due to the possible extension to the paralaryngeal space and the subglottis [10]

The mean age reported was above  $57 \pm 7$  years in the majority of studies [3,4,11]. According to the same studies, the number of male patients is considerably higher compared to females. Eighty-one percent of our patients were cigarette smokers. Cigarette smoking rate reached 90% in many reports with an association to alcohol beverage in almost half of cases [3,12]. Hoarseness was the chief complaint in our study. In fact this is the main symptom leading to diagnosis especially in the early stage of the disease [13]. Studying VC mobility using office endoscopy is an important step in physical examination. In fact, Arytenoid fixation remains a classic contraindication to the FAL. Nevertheless, Lawson et al reported the feasibility of Tucker's technique in well selected T3 patients with laryngeal fixation [5].

Fourteen patients underwent ipsilateral neck dissection. Thirteen among them had supra glottic extension and N0 necks. In fact, Neck dissection is not recommended for T1 patient but remains controversial for T2 patients (5% risk of nodal metastasis) [14]. Mallet et al [6], studied the oncologic results after FAL in 65 patients. Two patients (3%) with T2N0 tumor presented nodal relapses. Laccourrey reported more frequent regional relapses in case of extension to Morgani Ventricules or the subglottis [15]. However, according to Akyildiz [4], T1N0 and T2N0 patients presented a low risk of occult nodal metastasis (1.5%). Therefore neck dissection is not justified for these patients

The mean hospital stay in our series was  $19 \pm 4$  days. Bakhos et al [3], reported an average hospital stay of  $17.3 \pm 7.5$  in the FAL group of patients. Median decannulation time was  $13 \pm 5.1$  days in our series. The average time of nasogastric tube removal was 18

±7.3 days. Akyildiz et al decannulated their patients in a mean delay of 12 days from surgery [4]. The same authors removed nasogastric tube in an average time of 10 days [4]. Mallet et al [6], decannulated their patients in a mean delay of 12 days. This delay Ranged between 6 and 16 days in the series of Schechter [16]. It is recommended to proceed for decannulation after removal of the nasogastric tube and checking the patient had good swallowing function. Lawson et al, practiced cinema radiography to check the absence of false passage before removing the cannula [5]. In our experience, late removal of nasogastric tube prevented aspiration. Fourteen (29%) among our patients developed post operative complications. Ganly et al analyzed postoperative complications of open partial laryngectomies in 150 patients; Twenty percent (20%) of patients developed postoperative complications [17]. According to the same authors, the prevalence of postoperative complications with the FAL reached 14% [17]. The Infection of the tracheostomy site was the most frequent postoperative complication (19%). Zhao et al [18], evaluated the postoperative results of 38 patients treated by FAL. The postoperative infectious complications rate was 7.9%. This rate reached 3.4% in the series of Liu et al [19]. Two among our patients presented cervical emphysema during the postoperative time. It was the most frequent complication reported by Akyildiz et al and Liu et al reaching respectively 5.8% and 10% [4, 19]. No aspiration pneumonia was recorded in these studies. Four among the patients of Zanaret et al developed aspiration pneumonia and required hospitalization and Intra venous antibiotherapy [20].

Two patients in this report developed glottic synechia as a late complication and were managed during transoral CO2 laser sessions. No permanent tracheostomy was kept. Daniilidis et al [21], reported 5 cases of laryngeal Stenosis as late postoperative complications. A permanent tracheostomy was required.

Satisfactory oncologic and functional results have been attributed to the FAL. The 5 years overall survival (OS) reported in many studies was between 81.5 and 100% [2, 4-6]. We achieved a 5 years OS rate of 97%. This rate was close to the OS achieved in the recent report of Akyildiz et al [4].

The 5-year disease-free survival in our report was 94%. This rate ranged between 87% and 94% in the literature [4, 6, 12, 22]. Lawson reported only one local relapse among 34 patients operated by FAL [5]. Nie et al [11], studied the oncologic outcomes of frontal vertical partial laryngectomy in 58 patients with T1 and T2 tumors with AC involvement. The 3-year local control rate reached 96.2% [11]. However, the 5-year local control rate didn't exceed 68% for Kardaz Ziemek et al [23]. In fact, according to Piquet et al, the paraglottic space control remains insufficient with Tucker surgery [8]. Therefore, these authors recommend this technique only in glottic tumors without impairment of VC mobility [8].

We treated local recurrence by TL and adjuvant RT.

Mallet reported 4 oncologic failures; locoregional recurrences were treated by TL and bilateral neck dissection followed by adjuvant RT [6]. Likewise, Bakhos et al managed local recurrence by TL and by Chemoradiation therapy in one case due to the early oncologic failure [22].

This study showed a statistically significant correlation between the tumor differentiation degree and the 3-year local control rate. No statistically significant difference was found related to the T stage. Akyildiz studied the 5-year local control rate after FAL; No statistically significant correlation was found related to the T stage and tumor's differentiation degree [4]. However, Brumund et al found a significant statistical relationship between an increase in local control and the following parameter: pathological margins involvement, anterior commissure involvement and increased T stage [24]. One of the main drawbacks of this study is its retrospective type. As a result, data collection was limited. However, the relatively important number of patients is a strong point. Akyildiz et al [4], reported the oncologic outcomes of Tucker surgery of 68 patients during period a study of 20 years. This number was 23 for Bakhos et al [22] and 65 for Mallet et al [6].

## CONCLUSION:

FAL with epiglottic reconstruction is a reliable technique in well-selected T1 and T2 glottic tumors. It offers good local control with a low postoperative morbidity rate. The relatively long hospital stay, wound healing, and the temporary tracheostomy issues remain the main drawbacks of this technique. The transoral laser cordectomy was recently reported as a good alternative to the FAL. A comparative study between these 2 therapeutic approaches in terms of oncologic and functional results would be interesting.

## Compliance with ethical standards

**Conflict of interest:** The authors stated that there is no conflict of interest.

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